

### **REMARKS**

Claims 28-30, 32, 34-36 and 63 are pending in this application. Claim 33 has been previously cancelled, and claims 37-62 have been withdrawn by the Examiner as directed to non-elected subject matter. Applicants expressly reserve the right to file one or more divisional applications directed to the non-elected subject matter.

According to the Office Action of October 4, 2007, claims 28-32, 34-36 and 63 have been examined on their merits, and have been objected to and rejected. In response, Applicants submit this amendment, which amends claims 28 and 34-36, and cancels claim 31. Claim 28 has been amended to add the limitation previously recited in claim 31, and claims 34-36 have been rewritten into independent form and recite the limitation of amended claim 28. No new matter has been added by these amendments. In view of the amendments to the claims and below remarks, Applicants respectfully request that the objections and rejections be reconsidered and withdrawn.

### **Claim Objections**

The Office Action asserts objections against claims 34-36 as failing to further limit the subject matter of a previous claim. Claims 34-36 have been re-written into independent form. Accordingly, Applicants respectfully request that this rejection be withdrawn.

### **Rejection under 35 U.S.C. § 112, Second Paragraph**

Claims 34-36 has been rejected under 35 U.S.C. § 112, second paragraph, for failing to particularly point-out and distinctly claim the subject matter that the Applicants regard as the invention. As the Applicants understand the rejection, the rejection was premised on the claims further limiting claim 28's recitation of "consisting essentially of titanium oxide". Since claims 34-36 have been re-written into independent form, it is clear that each claim recites a continuous film consisting essentially of titanium oxide and an additional oxide (claim 34); titanium oxide doped with a transition metal (claim 35); or titanium oxide wherein the substrate or the continuous film is colored (claim 36). Accordingly, withdrawal of this rejection is respectfully requested.

**Rejection Under 35 U.S.C. § 102**

Claims 28-30, 36 and 63 have been rejected under 35 U.S.C. § 102 as being anticipated by U.S. Pat. No. 5,919,422 to Yamanaka *et al.* (hereinafter "Yamanaka"). In view of the amendment to claim 28, which now incorporates the limitations previously recited in claim 31, claim 28 is not anticipated by Yamanaka. Claims 29, 30, 36 and 63 are also not anticipated by Yamanaka because they depend from claim 28. Accordingly, Applicants respectfully request that this rejection be withdrawn.

**Rejection Under 35 U.S.C. § 103**

Claims 31, 32, 34 and 35 have been rejected under 35 U.S.C. § 103(a) as unpatentable over Yamanaka in view of U.S. Pat. No. 6,103,363 to Boire *et al.* (hereinafter "Boire"). Since the limitations of claim 31 have been incorporated into claim 28, the rejection of claim 31 is reviewed as if directed to claim 28. Applicants respectfully traverse this rejection because the cited references, taken as a whole, fail to teach or suggest that the individual fibers are coated with a continuous film, fail to teach or provide motivation to alter Yamanaka so that the particle size is 50 nm or smaller, and are non-analogous prior art.

***I. The cited references do not teach a continuous film.***

The invention, as recited in claims 28, 32, 34 and 35, is a photocatalytic composite material comprising a mass of inorganic fibers. The surfaces of the individual fibers are coated with a continuous film of photocatalyst. The continuous film is defined by the specification as a film that is "substantially free from peels, detachments and cracks" (specification at page 4, lines 8-16).

On page 3, the Office Action contends that Yamanaka teaches each and every limitation previously recited in claim 28. In pertinent part, the Office Action contends that the "the substrate of the curtain (181) is made from a glass-fiber woven cloth, which is coated with a continuous film (183 and 185) of titanium dioxide (a titanium oxide) photocatalyst (Column 24, lines 3-14)" (Office Action at page 3).

Yamanaka is directed to a vehicle curtain comprising a substrate 181, such as a curtain cloth, and a photocatalyst 183 and 185 on opposite surfaces of the substrate. Each

photocatalyst 183 and 185 is a titanium dioxide film disposed continuously in a plane of the substrate 181. Yamanaka's "continuous film" would not be continuous as defined in the present specification. Yamanaka teaches preparing its film by a sol-gel method or film lamination (Yamanaka, column 25, lines 51-57). Film lamination cannot form a continuous film on the circumferential surface of each fiber. Nor can the sol-gel method, as evidenced by the present specification, Run No. 11 (see specification at page 21, lines 12-29).

In Run No. 11, sol-gel was tested as a wet process for Example 1. The resulting film was not a continuous film and had numerous discontinuities such as detached portions, steps and powder deposition (page 21, lines 20-26). Therefore, when the surface of minute fibers is concerned, a sol-gel method cannot form a continuous film.

The Office Action does not contend that Boire overcomes this deficiency. Moreover, Boire does not teach or suggest a continuous film covering a circumference of a fiber. Boire is directed a photocatalytic coating that exhibit a marked dirt-repellent effect. The substrates in Boire are glass panels or ceramic substrates, which are planar. In Boire, the sol-gel technique and the CVD technique are alternatives to each other, and therefore Boire only teaches applying a film to a plane of the substrate. However, in the present invention, a continuous film cannot be formed by a sol-gel technique. Only a CVD method where the substrate is pre-heated in the range of 100-300°C forms the recited continuous film circumferentially around the fibers. Since Boire teaches using a sol-gel method, it is directed solely to applying a film on a plane of a substrate, does not suggest forming a continuous film circumferentially around a fiber.

In order for the cited references to make the recited invention obvious, they must teach or suggest a continuous film covering a mass of inorganic fibers. In this case, Yamanaka and Boire, viewed as a whole, do not teach such a film. Therefore, the Office Action has failed to make a *prima facie* showing that the cited references, taken as a whole, teach or suggest a continuous photocatalytic film covering the circumferential surfaces of a mass of fibers, as recited in claim 28, 34 and 35. The cited references also do not teach or suggest the invention as recited in claim 32 because claim 32 depends from claim 28. Accordingly, reconsideration and withdrawal of this rejection is respectfully requested.

***II. Particles 50 nm or smaller are not obvious in view of the cited references.***

Claims 28, 32, 34 and 35 also recited that the average crystallite diameter of 50 nm or smaller. This limitation is not obvious in view of the cited references.

In order for a continuous film to be formed where the average crystallite diameter is 50 nm or smaller, the substrate must be pre-heated to 100 – 300°C. On page 4, the Office Action acknowledges that Yamanaka does not explicitly teach the size of the crystallites, but claims that (1) the crystallites in Yamanaka inherently have an average size of between 0.5 to 100 nm, or (2) crystallites with an average size between 0.5 and 100 nm would be obvious in view of Boire.

Yamanaka does not inherently teach crystallites having an average size between 0.5 and 100 nm. To establish inherency, the Patent Office must set forth extrinsic evidence that the missing descriptive matter is necessarily present in the thing described by the reference, and that the missing descriptive matter would be recognized by a person of ordinary skill in the art. *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999). “Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.” *Continental Can Co. v. Monsanto Co.*, 948 F.3d 1264, 1268 (Fed. Cir. 1991).

In this case, crystallites in Yamanaka do not inherently have an average size smaller than 50 nm. The invention recited in claim 28 is prepared by initially preheating a mass of inorganic fibers to 100 – 300°C, contacting the vapors for CVD (titanium tetrachloride and water vapors), and then further heating the crystallization of the coated film to form a crystalline titanium oxide film (see specification example 1, pages 18-21; and example 3, pages 25-27). If the temperature of the preheated substrate at the time of CVD is higher than 300°C, the resulting titanium oxide film has an average crystallite diameter larger than 50 nm, poor adhesion, and decreased photocatalytic activity, as evidenced by the specification at Table 1 (No. 10) and Table 2. If the temperature of the preheated substrate at the time of CVD is lower than 100°C, the film will have cracks, poor adhesion, and therefore will not be continuous and will have decreased photocatalytic activity (see specification at Table 1, No. 5; and Table 2).

Yamanaka discloses a titanium dioxide film applied by vapor phase growth process, such as a vacuum deposition process or a chemical precipitation process, and is calcined to form a photocatalyst. However, according to this process, the particles would be far greater than 50 nm. The calcination can be done by preheating the substrate prior to vapor phase growth for simultaneous film formation and calcination, by heating and vapor phase growth simultaneously, or by heating the substrate after vapor phase growth. In Yamanaka, the calcination temperature is between 600 and 700°C. At this temperature, the average size of the crystallite would be larger than 50 nm. For example, Run No. 10 in the specification (page 21) provides that when the substrate is preheated to 400°C, the average crystallite diameter is far greater than 50 nm. It is therefore expected that preheating the substrate to 600 or 700°C would also produce average crystallite diameter far greater than 50 nm. As such, Yamanaka does not inherently teach a film having an average crystallite size of 50 nm or smaller because Yamanaka's film has an average crystallite size far greater than 50 nm.

A photocatalytic film on a mass of inorganic fibers having an average crystallite diameter of 50 nm or less is not obvious in view of Yamanaka and Boire because there is no motivation to combine the references. "[A] patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR Int'l.*, 127 S.Ct. 1727, 1741. "[I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does". *Id.* Examples of rationales to support a *prima facie* showing of obviousness are provided in MPEP (Rev. Sept. 6, 2007) § 2143:

- (A) Combining prior art elements according to known methods to yield predictable results;
- (B) Simple substitution of one known element for another to obtain predictable results;
- (C) Use of known technique to improve similar devices (methods, or products) in the same way;
- (D) Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- (E) "Obvious to try" – choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;

(F) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art;

(G) Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teaching to arrive at the claimed invention.

The key to supporting any rejection under 35 U.S.C. 103 is the clear articulation of the reason(s) why the claimed invention would have been obvious. The Supreme Court in *KSR* noted that the analysis supporting a rejection under 35 U.S.C. 103 should be made explicit.

The reasoning behind this requirement is to ensure that hindsight is not used. MPEP § 2145.

The Office Action fails to provide any reason to combine Yamanaka and Boire. Instead, it merely states that “it would be obvious to one of ordinary skill in the art to form crystals of this size, as taught by Boire, in order to maximize the photocatalytic effect” (Office Action at page 4). However, mere conclusory statements are insufficient to establish the requisite motivation. See MPEP § 2141, *citing In re Kahn* 441, F.3d 977, 988 (Fed. Cir. 2006).

Although the Applicants are not required to establish a lack of motivation to combine the references, it is apparent that one of ordinary skill in the art would not be compelled to combine the teachings of Yamanaka and Boire to develop a film according to Yamanaka that has the size characteristics of Boire. In order to accomplish this, there must be some motivation to alter Yamanaka’s temperature parameters and method of applying the film. The Office Action contends that “Boire (Column 2, lines 5-30) further teaches that crystallites should have an average size of between 0.5 and 100 nm, preferably 1 to 50 nm, in order to have optimum photocatalytic effect” (Office Action at page 4). However, this does not provide any motivation to reduce the temperature to 100 – 300°C in Yamanaka’s procedure, or to use CVD instead of the sol-gel or film lamination processes, two critical elements necessary to achieve the recited particle size. Moreover, Boire fails to provide the requisite motivation to alter Yamanaka. Boire is directed to a glass or ceramic substrate having a photocatalytic coating on at least a portion of its surfaces. The coating formed by thermal decomposition of a titanium precursor such as organo-metallic precursors or metallic halide precursors, wherein the crystalline size of the titanium oxide is preferably 1-50 nm.

Deposition by CVD from titanium tetrachloride is one technique disclosed in Boire (column 1, lines 53-65). However, as illustrated in examples 4-7, the deposition is carried out at approximately 425°C. Thus, Boire does not provide motivation to reduce Yamanaka's temperature to 100 - 300°C; thus, there is no motivation to combine the references or modify Yamanaka to produce particle sizes that are 50 nm or smaller.

***III. The cite references are not analogous to the invention.***

Both of the cited references are directed to coating a planar surface, not an inorganic mass of fibers. According to MPEP § 2141.01(a),

The examiner must determine what is "analogous prior art" for the purpose of analyzing the obviousness of the subject matter at issue. "Under the correct analysis, any need or problem known in the field of endeavor at the time of the invention and addressed by the patent [or application at issue] can provide a reason for combining the elements in the manner claimed." *KSR International Co. v. Teleflex Inc.*, 550 U.S. \_\_\_, \_\_\_, 82 USPQ2d 1385, 1397 (2007). Thus a reference in a field different from that of applicant's endeavor may be reasonably pertinent if it is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his or her invention as a whole.

As discussed above, neither cited reference teaches or suggests a continuous film circumferentially covering a mass of inorganic fibers. Instead, both of the references are directed to coating substantially planar objects. In the present invention, the coating is applied circumferentially to the fibers. Thus, the references are not within the field of endeavor of coating fibers. Nor has the Office Action cited why a skilled artisan logically would have commended himself or herself to the references when working on the invention at hand. There is no explanation why a skilled artisan trying to coat a three-dimensional fiber with a continuous coat would look to references directed to coating planar objects.

Thus, these references are non-analogous, and cannot be used to support a rejection under 35 U.S.C. §103.

**CONCLUSION**

In view of the foregoing amendments and remarks, Applicants respectfully submit that all pending claims in the instant application are patentable over the prior art and are in condition for allowance. Accordingly, reconsideration and withdrawal of the rejections and a notice of allowance are respectfully requested. Should the Examiner have any questions or concerns, the Examiner is invited to contact Applicants' undersigned attorney by telephone at 412-471-8815.

Respectfully submitted,

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